

AMERICAN SOCIETY OF HEATING, REFRIGERATION AND AIR-CONDITIONING  
ENGINEERS, INC.

1791 Tullie Circle, NE / Atlanta, GA 30329  
404-636-8400

TC/TG/TRG MINUTES COVER SHEET

(Minutes of all meetings are to be distributed to all persons listed below within 60 days following the meeting.)

TC/TG/TRG No. TC 4.7 DATE: July 5, 2010

TC/TG/TRG TITLE: Energy Calculations

DATE OF MEETING: June 29, 2010 LOCATION: Albuquerque

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS & ADDIT'L ATTENDANCE
Philip Haves (CHAIR)	2008	Jan Hensen	2008	
Jeff Haberl (V CHAIR)	2009	Peter Ellis	2006	
Joel Neymark (STDS S.C.)	2007	Russ Taylor	2009	
Joe Huang	2009	Robert Sonderegger	2008	
Iain MacDonald	2009	Klaus Sommer (INT'L)	2007	
Dru Crawley	2008	Moncef Krarti	2007	See attendance list for
Timothy McDowell (SEC)	2008	Jan Kosny	2006	Additional attendees.

DISTRIBUTION

**ALL MEMBERS OF THE TC/TG/TRG**

TAC CHAIR	Donald Brundage
TAC SECTION HEAD	Suzanne LeViseur
SPECIAL PUBLICATIONS LIAISON	Stanley Mumma
STANDARDS LIAISON	Andrew Nolfo
HANDBOOK LIAISON	Peter Simmonds
RAC RESEARCH LIAISON	John House
PROF DEV COMM LIAISON	Fiorentino Mendez
CHAP TECH TRANSFER LIAISON	Andrew Cochran
STAFF LIAISON (RESEARCH)	Michael R Vaughn
STAFF LIAISON (TECH SERVICES)	Michael R Vaughn
STAFF LIAISON (STANDARDS)	Stephanie Reiniche

**These draft minutes have not been approved and are not the official, approved record until approved by this committee.**

**ASHRAE TC 4.7 Energy Calculations**

**ALBUQUERQUE MEETING**

**MOTIONS AND ACTION ITEMS**

MOTION: "Approval of the minutes from the meeting in Orlando" moved Neymark/Huang (6-0-0 CNV)

MOTION: "Accept the Final Report of RP-1456" Huang/MacDonald (6-0-0 CNV)

MOTION: "Approval of the TC4.7 Program Plan" Haberl/Huang (6-0-0 CNV)

MOTION: "TC 4.7 Recommends that ASHRAE form a Standards Project Committee titled "HVAC&R Equipment Performance Data Exchange Protocols for Energy Simulation " Neymark/MacDonald (7-0-0) 5 absent

MOTION: "TC 4.7 Recommends that Charles S. Barnaby be chair of the Standards Project Committee titled "HVAC&R Equipment Performance Data Exchange Protocols for Energy Simulation " McDowell/MacDonald (7-0-0) 5 absent

MOTION: "TC4.7 form a working group to review the rules extracted from COMNet for use in ASHRAE BuildingEQ and report to ASHRAE within 30 days" Huang/Crawley (7-0-0)

AMERICAN SOCIETY OF HEATING, REFRIGERATION AND AIR-CONDITIONING ENGINEERS, INC.  
 1791 Tullie Circle, NE / Atlanta, GA 30329  
 404-636-8400

**TC/TG/TRG MINUTES COVER SHEET**

(Minutes of all meetings are to be distributed to all persons listed below within 60 days following the meeting.)

TC/TG/TRG No. TC 4.7 DATE: July 5, 2010  
 TC/TG/TRG TITLE: Energy Calculations  
 DATE OF MEETING: June 29, 2010 LOCATION: Orlando

TC/TG/TRG MEETING SCHEDULE					
LOCATION – past 12 months		DATE	LOCATION - planned next 12 months		DATE
Orlando		January 26, 2009	Las Vegas, NV		January, 2011
Louisville		June 23, 2009	Montreal		June, 2011
TC/TG/TRG SUBCOMMITTEES					
Function			Chair		
Program			Michael Wetter		
Research			Joe Huang		
Handbook			Chip Barnaby		
RESEARCH PROJECTS – Current			Monitoring	Report Mode	
Project Title	Contractor		Comm.Chm.	At Meeting	
Appendix 1					
LONG RANGE RESEARCH PLAN					
Rank	Title	W/S Written	Approved	To R & T	
	Appendix 2				
HANDBOOK RESPONSIBILITIES					
Year & Volume	Chapter Title	No.	Deadline	Handbook Subcom. Chair/Liaison	
2009 Fundamentals	Energy Estimating Methods	19	June 2011	Barnaby/Simmonds	
STANDARDS ACTIVITIES - List and Describe Subjects					
SPC 140 Standard Method of Test for Building Energy Software – Joel Neymark					
TECHNICAL PAPERS from Sponsored Research - Title, when presented (past 3 yrs. present & planned)					
Appendix 3					
TC/TC/TRG Sponsored Symposia - Title, when presented (past 3 yrs. present & planned)					
Appendix 4					
TC/TG/TRG Sponsored Seminars - Title, when presented (past 3 yrs. present & planned)					
Appendix 5					
TC/TG/TRG Sponsored Forums - Title, when presented (past 3 yrs. present & planned)					
Appendix 6					
JOURNAL PUBLICATIONS - Title, when published (past 3 yrs. present & planned)					
None					

**Attendance**

Below is a complete listing of attendees at this and the prior three meetings. It includes the voting members of the committee listed on the first page.

Present at Meeting				Last name	First name	Membership
Albuquerque June 2010	Orlando January 2010	Louisville June 2009	Chicago January 2009			
						V= Visitor VM = Voting CM = corres.
X	X	X	X	Abushakra	Bass	CM
X	X		X	Anderson	J.R.	V
X			X	Armstrong	Peter	
X	X	X	X	Balbach	Chris	V
			X	Baltazar	Juan-Carlos	V
X	X	X	X	Barnaby	Chip	CM
X				Bertagnolio	Stephane	V
		X		Bobker	Michael	V
X			X	Bourassa	Norm	CM
X				Brandemuehl	Micael	CM
	X			Brantley	John	V
X	X	X	X	Carpenter	J Patrick	CM
			X	Chaisuparasmikul	Pongsak	V
	X		X	Cho	Soolyeon	V
	X	X	X	Claridge	David	CM
			X	Coffey	Brian	V
X	X	X	X	Cornick	Steve	V
X	X	X	X	Crawley	Dru	VM
X	X	X	X	Degelman	Larry	CM
X	X			Eldridge	David	V
			X	Ellis	Peter	VM
	X			Fang	Xia	V
		X		Field	Kristin	V
	X			Firraniello	Joseph	V
X		X	X	Fisher	Dan	CM
			X	Gardner	Carol	
X	X	X	X	Haberl	Jeff	VM
	X	X	X	Haddad	Kamel	CM
X	X	X	X	Haves	Philip	VM
	X			Hermesen	Austin	V
		X		Hittle	Doug	CM
		X	X	Hong	Tianzhen	V
X				Howe	Bob	V
	X			Hooper	Brooks	V
		X		Horton	Travis	V
	X			House	John	V
X	X	X	X	Huang	Joe	VM
X	X	X	X	Judkoff	Ron	CM

Present at Meeting				Last name	First name	Membership
Albuquerque June 2010	Orlando January 2010	Louisville June 2009	Chicago January 2009			V= Visitor VM = Voting CM = corres.
	X			Kennedy	Mike	V
X				Kinney	Kris	V
X	X			Kolderup	Erik	V
	X			Koran	Bill	V
	X	X	X	Kosny	Jan	VM
	X	X	X	Krarti	Moncef	VM
X				Kruis	Neal	V
	X			Kummert	Michael	V
X				Laouadi	Aziz	V
			X	Laughman	Christopher	V
X				Lee	Kwang Ho	V
	X			Lemort	Vincent	V
X		X	X	LeViseur	Susan	TAC Sec Head
		X	X	Liesen	Richard	CM
			X	Logee	Terry	V
X			X	MacDonald	Iain	VM
X	X			Malherek	Elyse	V
X	X	X	X	McDowell	Tim	VM
	X	X	X	Mukhopadhyay	Jaya	V
X	X	X	X	Neymark	Joel	VM
	X		X	O'Neill	Zheng	V
X				Pang	Xiufeng	V
X	X	X	X	Pedersen	Curt	CM
X	X			Pegues	Jim	V
X				Ponoum	Ratcharit	V
X		X		Rees	Simon	CM
	X		X	Schaefer	Larry	V
	X			Schertz	Paul	V
			X	Selkowitz	Steve	V
X	X			Shirey	Don	CM
X		X		Shrestha	Som	V
	X		X	Smith	Vern	V
			X	Sloat	Cara	V
	X	X	X	Sonderegger	Robert	VM
	X	X	X	Sommer	Klaus	INT'L M
			X	Spitler	Jeffrey	
X		X	X	Stovall	Therese	V
X				Tabares	Paulo	V
		X		Taylor	Russell	VM
		X		Thevenard	Didier	V
	X			Tseng	Paul	V
	X			Verba	Roman	V

Present at Meeting				Last name	First name	Membership
Albuquerque June 2010	Orlando January 2010	Louisville June 2009	Chicago January 2009			V= Visitor VM = Voting CM = corres.
X	X	X	X	Wetter	Michael	CM
X				Wilson	Eric	V
	X			Winkler	Jon	V
		X	X	Wray	Craig	CM
		X		Wright	John	V
	X			Yuill	Gren	V
			X	Zhou	Liang	V
			X	Zmeureanu	Radu	V
X				Zuo	Wangda	V

**Appendix 1****TC 4.7 RESEARCH PROJECTS STATUS****ASHRAE****Technical Committee 4.7 Energy Calculations  
(January 26, 2010)****Active projects**

<b>#</b>	<b>Title</b>	<b>Joint TC</b>	<b>Cog SC/ Contractor</b>	<b>PMSC</b>	<b>Dates / status</b>
1197-RP	Update Energy Calculations for Residential HVAC Equipment		Sim/Comp, Univ of Colo	Chip Barnaby	Awaiting submission of final paperwork
1416-RP	Development of Internal Surface Convection Correlations for Energy and Load Calculations	4.1	Sim/Comp, Univ of Texas	Dan Fisher (Chair), Steve Bruning, Jan Kosny	In Progress
1456-RP	Assess and Implement Natural and Hybrid Ventilation Models in Whole-building Energy Simulations	4.10	Sim/Comp, Univ of Colo	Joe Huang (Chair) Philip Haves, Jan Hensen, R.Banks, N.Bourassa, S.Szymurski	Awaiting submission of final paperwork
1404-RP	Modeling, Analysis, and Reporting Protocols for Predicting Annual Energy Performance from Short-Term Building Energy Monitoring		DDM, Milwaukee School of Engineering	R. Sonderegger (Chair) J. Haberl, V. Smith	In Progress

**Appendix 2**  
**RESEARCH PLAN**

**ASHRAE**  
**Technical Committee 4.7 Energy Calculations**  
**2010 Research Plan (Jan 29, 2010)**

<b>Title</b>	<b>Society status</b>	<b>TC 4.7 Status</b>	<b>Actors or TC 4.7 Prime Contact</b>	<b>Subcommittee*</b>
<b>Active projects</b>				
1197-RP Update energy calculations for Residential HVAC equipment	awaiting final disposition	Project completed, but forms need to be turned in to ASHRAE	Barnaby (chair)	SCM
1416-RP Development of Internal Surface Convection Correlations for Energy and Load Calculations	project underway	Third PMS meeting held Orlando Jan '10	Contractor: UTexas PMS: DFisher (chair), SBruning, JKosny	SCM
1456-RP Assess and implement natural and hybrid ventilation models in whole-building energy simulations	project underway	Contractor delivered final report Oct '09; PMS met in Orlando, but could not vote due to lack of quorum, PMS will review final report and do a letter ballot by Mar '10, 6-mos. NCX to July '10.	Contractor: UColo PMS YJHuang (chair), PHaves, JHensen, RBanks, CScrutton, XDWang, HDavies	SCM
1404-RP Modeling, analysis, and reporting protocols for predicting annual energy performance from short-term building energy monitoring	Project awarded Jul 09, contract signed Sep 09	First PMS held in Orlando Jun10	Contractor: UMilwaukee PMS: RSonderegger (chair), JHaberl, VSmith	DDM
<b>WSs approved by TC</b>				
1588-WS Procedure to create hypothetical layer-by-layer fenestration descriptions when only the bulk properties such as U-factor and SHGC have been defined	RTAR accepted Jan 09	TC 4.5 voted to co-sponsor; WS approved by full committee in Orlando Jan '10 to be forwarded to RAC.	YJHuang (WS author), proposed PES JHaberl (chair), CBarnaby, TMcDowell, + TC4.5 rep to be determined	A
<b>co-sponsored WSs under development</b>				
WS-1413 Developing standard procedures for filing missing weather data (TC 4.2 lead)	WS returned to TC4.2 Jun '09, TC 4.2 letter ballot of revised WS to be held after Orlando	Co-sponsorship approved by full committee in Salt Lake City Jun 08	YJHuang (TC 4.7 contact)	DDM

**Appendix 3**  
**TECHNICAL PAPERS FROM SPONSORED RESEARCH**

<b>RP</b>	<b>Title</b>	<b>Contractor</b>	<b>Approved</b>	<b>Paper</b>
1051	Procedures for Reconciling Computer-calculated Results with Measured Energy Data	Drexel	Chicago January 2006	Reddy, T.A., 2006. "Literature Review on Calibration of Building Energy Simulation Programs: Uses, Problems, Procedures, Uncertainty and Tools", ASHRAE Transactions, vol 112(1).
1051	Procedures for Reconciling Computer-calculated Results with Measured Energy Data	Drexel	Chicago January 2006	Sun J. and Reddy T.A., 2006, "Calibration of Building Energy Simulation Programs Using the Analytic Optimization Approach (RP-1051)", Int. J HVAC&R Research 12(1) 177-196.
1051	Procedures for Reconciling Computer-calculated Results with Measured Energy Data	Drexel	Chicago January 2006	Reddy, T.A., I. Maor and C. Pongjapornpon, 2006, "Calibrating Detailed Building Energy Simulation Programs with Measured Data- Part I: General Methodology", accepted for publication in Int. J HVAC&R Research.
1051	Procedures for Reconciling Computer-calculated Results with Measured Energy Data	Drexel	Chicago January 2006	Reddy, T.A., I. Maor and C. Pongjapornpon, 2006, "Calibrating Detailed Building Energy Simulation Programs with Measured Data- Part II: Application to Three Case Study Office Buildings", accepted for publication in Int. J HVAC&R Research.
865	Accuracy Tests for Simulations of VAV Dual Duct, Single Zone, Four Pipe Fan Coil and Four Pipe Induction Air Handling Systems (4796)	Univ Nebraska, Texas A&M	July 2002	Yuill, G., Haberl, J. 2006. "Accuracy Tests for Simulations of VAV Dual Duct, Single Zone, Four Pipe Fan Coil and Four Pipe Induction Air Handling Systems (4796)," ASHRAE Transactions-Research, Vol. 112, Pt. 1 (January).
865	Accuracy Tests for Simulations of Constant Volume, Dual Duct and Variable Volume Air Handling Systems (4796).	Univ. Nebraska, Texas A&M	July 2002	Yuill, G., Haberl, J., Caldwell, J. S. 2005. "Accuracy Tests for Simulations of Constant Volume, Dual Duct and Variable Volume Air Handling Systems (4796, RP-865)," ASHRAE Transactions-Research, Vol. 111, Pt. 2, No. 4796, pp. 137 – 153 (June).

1050	Development of an Inverse Model Toolkit	Univ. of Dayton, Texas A&M	December 2001	Kissock, K., Haberl, J., Claridge, D. 2003. "Inverse Model Toolkit (1050-RP): Numerical Algorithms for Best-Fit Variable-Base Degree-Day and Change-Point Models," ASHRAE Transactions-Research, Vol. 109, Pt. 2, pp. 425 – 434.
1050	Development of an Inverse Model Toolkit	Univ. of Dayton, Texas A&M	December 2001	Haberl, J., Claridge, D., Kissock, K. 2003. "Inverse Model Toolkit (1050-RP): Application and Testing," ASHRAE Transactions-Research, Vol. 109, Pt. 2, pp. 435 – 448.
1093	Diversity Factors and Schedules for Energy and Cooling Load Calculations	Texas A&M	June 2000	Abushakra, B., Haberl, J., Claridge, D. 2004. "Overview of Literature on Diversity Factors and Schedules for Energy and Cooling Load Calculations (1093-RP)," ASHRAE Transactions-Research, Vol. 110, Pt. 1 (February), pp. 164 – 176.
1093	Diversity Factors and Schedules for Energy and Cooling Load Calculations	Texas A&M	June 2000	Claridge, D., Abushakra, B., Haberl, J. 2003. "Electricity Diversity Profiles for Energy Simulation of Office Buildings (1093-RP)," ASHRAE Transactions-Research, Vol. 110, Pt. 1, pp. 365 – 377 (February).

---

**Appendix 4**  
**TC/TG/TRG SPONSORED TRANSACTIONS SESSIONS**

**Current as of June 2010**

**PRESENT:**

**PLANNED:**

**PAST:**

Louisville, June 20-24, 2009

Transaction “Improving Load Calculations for Fenestrations with Shading Devices”

Chicago, January 24-28, 2009

HVAC&R Research Seminar “Synthesis of Optimum HVAC System Configurations”

New York City/January 2008

How Low Can You Go?

Recent Advances in Energy Simulation (Chair: Dan Fisher)

How Low Can You Go? Low-Energy Buildings Through Integrated Design (Chair: Dru Crawley)

Application of Inverse Models (Chair: Jeff Haberl)

---

**Appendix 5**  
**TC/TG/TRG SPONSORED SEMINARS**

**Current as of June 2010**

**PRESENT:**

**Albuquerque, June 26-30, 2010**

Building Energy Simulation 101

Track: Energy/Simulation

Organized by: TC 4.7

Chair: Tim McDowell

Simulation of HVAC/R equipment and systems using the limited data published by manufacturer

Track: Systems and Equipment

Organized by: TC 4.7 (Simulation and Component Models)

Chair: Michael Wetter

**PLANNED:**

**Jan 29-Feb 2, 2011 - Las Vegas, NV**

“Building Energy Simulation 102”

Track: Professional Skills

Chair: Keith Cockerham

“Modeling of High Performance Buildings”

Track: -

Chair: Xia Fang

“Modeling of Existing Buildings”

Chair: Sue Reilley

**PAST:**

**Orlando, January 23-27, 2010**

Web-based Programs for Calculating Energy Code-Compliance (Chair: Larry Degelman)

How to Assess the Performance of Sustainable Buildings (Chair: Moncef Krarti)

**Louisville, June 20-24, 2009**

Energy modeling of large buildings systems

**Salt Lake City June 21-25, 2008**

Use of Equation Solvers for Simulation (Chair: Michael Wetter)

**New York City/January 2008**

How to model nothing – Energy Modeling for Zero Net Energy Buildings: Parts 1 & 2 (Chair: Jan Kosny)

**Long Beach/June 2007**

Simulation Support for the 2007 Solar Decathlon (Chair: Kamel Haddad)

---

Dallas/January 2007

Use of 'equation solvers' for Simulation (Chairs: Jean Lebrun/Mike Wetter)

Applications of Computer Simulation in High Performance Buildings (Chair: Martha Brook)

Québec City/June 2006

None

Chicago/January 2006

How and Why to Calibrate a Simulation to Measured Data (Chair: Robert Sonderegger)

Application and Experiences with the New Simulation Software (Chair: Dan Fisher)

Denver/June 2005

Neglected Topics in Building Simulation (Chair: Ian Beausoleil-Morrison).

Orlando/January 2005

What to do When Data Misbehave (Chair: Agami Reddy)

---

**Appendix 6**  
**TC/TG/TRG SPONSORED FORUMS**

**Current as of June 2010**

**PRESENT:**

**Albuquerque, June 26-30, 2010**

None

**PLANNED (w/priorities):**

**Jan 29-Feb 2, 2011 - Las Vegas, NV**

**PAST:**

Chicago, January 24-28, 2009

“Limitation of Energy Simulations for NZEB”

Chicago/January 2006

What Controls Modeling Capabilities are Needed for Energy Simulations? (Chair: Philip Haves)

**ASHRAE TC 4.7 Energy Calculations**

Tuesday, June 29, 2010, 6:00-8:30 p.m.

Albuquerque

**1. Roll call and introductions (McDowell)**

- The meeting convened at 6:08 PM.
- 6 voting members were present, excluding the chair, out of 12 non-international members, constituting a quorum.
- Those present introduced themselves.

**2. Accept agenda & approve minutes of Orlando meeting (Haves) (Agenda: Attachment A)**

- The agenda was approved by voice vote.

MOTION: "Approval of the minutes from the meeting in Orlando" moved Neymark/Huang (6-0-0 CNV)

**3. Announcements/Liaisons (Haves)**

- TAC Section Head LeViseur – presented Phil Haves with certificate of thanks for service
- Reaffirmed the purpose and scope of the TC, but need to change from chapter number to the title of the handbook chapter.
- Society is encouraging TC to use Google groups and ASHRAE will provide web conference services for official activities. Request should be sent to Miek Vaughn.
- Hightower award – nominations are due September 1.
- CCTV – wants to get grassroots members more active in TC, possibly in reviewing handbook chapters. A "help wanted" page for TCs will be added to the ASHRAE website.
- Government affairs has made 15 trips to the hill
- Encouragement new members to TCs. Old members should mentor younger members.
- A new section on the society website for Tech Council steering committees work is reported.

**4. Membership (Haves)**

- Rolling Off: Ellis, Haves, Kosny, Taylor
- Rolling On: Barnaby, Balbach, Wetter
- New Officers: Haberl - chair, McDowell - vice chair, Huang - secretary, Balbach - research

**5. Subcommittee reports****5.1 Research Joe Huang (chair) reporting:**

- In workstatements, the intended placement of the paper must be explicit e.g., HVAC&R Journal or ASHRAE Transactions.
- 1404-RP – PMSC chair reporting – conference call with PMSC – substantial progress has been made on the first two case-study sites.
- 1416-RP – PMSC chair reporting – spectacular progress originally planned for 48 experiments and contractor has run 220 tests providing a rich data set. Experiments are now complete and work is progressing on developing the correlations. One paper has been published and final report should be ready for Montreal. The new correlations need to be added to the loads toolkit.
- 1456-RP – PMSC chair reporting – Huang reporting – the final report was submitted in October and the PMS has finished with comments and recommended that the full committee approve final report. A working group will produce a RTAR/WS based on the recommendation for further work in the final report.

MOTION: "Accept the Final Report of RP-1456" Huang/MacDonald (6-0-0 CNV)

- WS-1588 - accepted as a WS in Orlando and submitted to RAC, the WS has been returned but letter has not been received. The comments will be addressed and returned to RAC.

- ASHRAE is short of money and not likely that anything will go out for bid this Fall, but expect to clear the back-log in the Spring. Co-sponsorship would help success of projects.
- New strategic research plan – any new RTARs should align with research plan
- Topics discussed in subcommittees – possible next steps in natural ventilation work, use of Modelica as a neutral platform for models developed in ASHRAE and support modeling of controls, reconciling simulated and measured performance, COMNet

#### **5.2 Handbook, Chip Barnaby (chair) reporting:**

- HOF will be reissued in 2013. A committee of volunteers to review the chapter has been formed and will report on potential changes in Las Vegas. A Handbook subcommittee meeting will be held in LV to discuss the outline of changes. Any further volunteers should contact Barnaby.
- 1 review has been received from college of fellows that would like to see more examples of applications of energy models. Should this be in the HOF or elsewhere in the handbooks.

#### **5.3 Program, Michael Wetter (chair) reporting:**

- 5 submissions in current conference 1 not scheduled
- 3 seminars for Las Vegas – all have speakers

MOTION: “Approval of the TC4.7 Program Plan” moved Haberl/Huang (6-0-0 CNV)

#### **5.4 Standards, Ron Judkoff (chair of SSPC 140) reporting**

- SSPC 140 – new test suites have been added: HERS BESTEST (Addendum B to 2007) will be published this summer, Ground Coupling (Addendum A to 2010) will be sent out for public review in the Fall, Multi-Zone (Addendum B to 2010) will go out for letter ballot to SSPC 140 this summer. The continuous maintenance version (2010) will be published Fall/Winter. 140 has been reference in IRS rules for tax credits, RP 865 – HVAC air side tests is being adapted to standard language, should be a 2 year project, ASHRAE staff has informed the committee that the IGCC wants to reference 140 but is concerned about the non-mandatory language used in the standard – this language will be cleaned up with ASHRAE staff, referenced by 90.1, 189, COMNet, IEC, RESNET, Future possible test suites have been listed in the SSPC minutes send comments to the SSPC
- SSPC 140 – The parameter space of building simulation is quite large and means there are many things that can be tested. Standard started with building envelope which was rather straightforward, but HVAC equipment and innovated building techniques are more difficult. All of this is deemed important. There are important issues, but the work to develop empirical data for validation is large and expensive. Historically we have looked at the most used features first.
- (Barnaby reporting) Proposed SPC on HVAC Equipment Performance Data Protocols for Energy Simulation - TPS was discussed in the subcommittee on Monday evening. Building equipment was changed to HVAC&R equipment.

MOTION: “TC 4.7 Recommends that ASHRAE form a Standards Project Committee titled “HVAC&R Equipment Performance Data Exchange Protocols for Energy Simulation “ Neymark/MacDonald (7-0-0) 5 absent

MOTION: “TC 4.7 Recommends that Charles S. Barnaby be chair the Standards Project Committee titled “HVAC&R Equipment Performance Data Exchange Protocols for Energy Simulation “ McDowell/MacDonald (7-0-0) 5 absent

#### **5.5 Website, chair not in attendance,**

- Contact the chair (Kris Kinney) with any changes or updates to the website.

#### **6. Reports on related activities (Various persons)**

- GPC 20, XML definitions – final galleys have been approved and will be published shortly
- TC 2.8 no report.
- TC 4.1, seminar on BIM to load calcs and honest with the issues.
- TC 4.2, 1477-RP preparing 3012 IWEC2 files, proposed research for transposition models of solar and handbook changes for clear sky model, working on the handbook chapter and any complaints, etc should be made known
- TC 4.3 measuring air tightness of high rise buildings – very leaky, WS out for bid on simulating multi-zone models, any comments on handbook.
- TC 4.5, no report.
- TC 6.5, project on-going to model for comfort conditions as a function of radiant conditions.
- TC 7.5, no report.
- TC 7.6, standards committee 90.1 – official approval for 2010 moved to end of July, new user-guide will be available in LV, move to coordinate comments to IECC.
- Building Smart, no report.
- IBPSA-USA, SimBuild 2010 – in August in NYC at Kimmel Center, large number of papers, poster competition, modeling competition, conference is close to full, BEMBOOK workshop will be presented at the conference, Lynn Bellinger is keynote
- IBPSA Canada, eSim 2010 was held in May, papers will be on the web site.
- IBPSA World, Building Simulation 2011 conference will be Wellington, New Zealand in November

### **7. Old Business**

(none)

### **8. Committee Structure**

- Past: Data Driven, Applications, Components, Handbook, and Research/Program floated. New format had time slot for research, no committees.
- Comment: the current format was exhausting, sitting in 2 or 3 meetings for 3 hours, not knowing when things were going to be discussed.
- Comment: mentioned that the most structured TCs use lots of subcommittees. Recommended going back to previous structure and fine-tune it. Doing things by topic was more productive. Good to have brainstorming, but not having follow-up was non-productive.
- Comment: not having a Handbook meeting was not good.
- Comment: need real working meetings like handbook.
- Comment: Needs to be a way that small groups can work on RTARs at the meeting...this has not happened. Comment: having 3 hours of meetings on Monday is hard to do when one has been getting up at 6:00 AM regularly. Comment: caution on going back to the way it was needs serious thought.
- Comment: Good to have breakout session...but not enough time.
- Comment: breakout session may only be enough time to get “idea” going.
- Comment: As former chair of SCM I knew I had to track “ideas”, whereas new structure had no assignments. Comment: reminder needs to go out about ACTION items, having subcommittees may help this.
- Comment: concentrate on fewer topics.

### **9. New Business**

- COMNet – several people have reviewed COMNet and informal discussions have demonstrated discomfort with the process, ASHRAE bEQ has recommended that the rules developed in COMNet be used for modeling the building performance, These rules have only been reviewed by 3 people. The lack of review is concerning. In conversation with Ron Jarnigan was that the committee did not want a review of COMNet, but on the rules extracted from COMNet for use in bEQ, but in fairly short order. A working group should be formed to review the rules and respond to the bEQ committee.

---

MOTION – “TC4.7 form a working group to review the rules extracted from COMNet for use in ASHRAE BuildingEQ and report to ASHRAE within 30 days” Huang/Crawley (7-0-0)

- Huang volunteers to chair – members Haberl, Crawley, Balbach, Neymark, Kinney.

**10. Adjourn**

- Meeting adjourns at 8:29.

**Attachments**

- A. Agenda
- B. Subcommittee Minutes
- C. Research Subcommittee Minutes
- D. Program
- E. SSPC 140 Minutes

## Agenda

### ASHRAE TC 4.7 Energy Calculations

Tuesday, June 29, 2010, 6:00-8:30 p.m.  
Brazos Room, Convention Center  
Albuquerque

- |  |                |
|--|----------------|
| 1. Roll call and introductions   | McDowell       |
| 2. Accept agenda & approve minutes of Orlando meeting  | Haves          |
| 3. Announcements/Liaisons  | Haves          |
| 4. Membership  | Haves          |
| 5. Subcommittee reports  |                |
| 5.1 Research   | Huang          |
| • <u>Status:</u> 1404-RP Modeling, analysis, and reporting protocols for predicting annual energy performance from short-term building energy monitoring (Milwaukee School of Engineering) |                |
| • <u>Status:</u> 1416-RP Development of Internal Surface Convection Correlations for Energy and Load Calculations (TC 4.1/4.7 Univ. of Texas at Austin)                                    |                |
| • <u>Status:</u> 1456-RP Assess and Implement Natural and Hybrid Ventilation Models in Whole-Building Energy Simulations (TC 4.10/4.7 Univ. of Colorado)                                   |                |
| • <u>Status:</u> 1588-WS Procedure to create hypothetical layer-by-layer fenestration descriptions when only the bulk properties such as Ufactor and SHGC have been defined                |                |
| • RTARs and Work statements for consideration  |                |
| • Requests for co-sponsorship  |                |
| 5.2 Handbook   | Barnaby        |
| 5.3 Program  | Wetter         |
| 5.4 Standards  | Neymark        |
| • SSPC 140 SMOT for Eval Bldg Energy Analysis Computer Programs  |                |
| • IEA Annex 34/43 Test and Validation of Bldg Energy Sim Tools   |                |
| • Proposed SPC on HVAC Equipment Performance Data Formats for Energy Simulation  |                |
| 5.5 Web Site   | Kinney         |
| 6. Related activities reports  |                |
| GPC 20 XML Definitions for HVAC&R  | Barnaby        |
| TC 2.8 Building Environmental Impacts and Sustainability   | ?              |
| TC 4.1 Load Calculation Data and Procedures  | Petersen       |
| TC 4.2 Climate Information   | Degelman       |
| TC 4.5 Fenestration  | Barnaby        |
| TC 6.5 Radiant Heating and Cooling   | Sommer         |
| TC 7.5 Smart Building Systems (now includes TC 7.4)  | Wetter         |
| TC 7.6 Systems Energy Utilization  | Abushakra      |
| BuildingSMART (formerly IAI International Alliance for Interoperability)   | Haves          |
| IBPSA: USA, SimBuild 2008; Canada, eSim 2006; IBPSA, BS 2009   | Haberl, Hensen |
| 7. Old Business  | (Haves)        |
| 8. Committee Structure   | Haves          |
| 9. New business  | (Haves)        |
| 10. Adjourn  |                |

**Attachment B**

## ASHRAE TC 4.7 Energy Calculations

**Subcommittee**

Monday, January 25, 2010, 6-9 pm

Albuquerque, New Mexico

Attendance: Tim McDowell, Iain MacDonald, Roger Grant, Aziz Laociax, Kamel Haddad, Kris Kinney, Brian Coffey, Eric Wilson, Neal Kruijs, Peter Armstrong, Ron Nelson, Mangesh Basarkar, Simon Rees, Xiufeng Pang, Kwang Ho Lee, Wangda Zuo, Michael Wetter, Chris Balbach, Bass Abushakra, Reid Hart, Jaya Mukhopadhyay, Dane Christensen, Brian Moura, Timothy Moore, John House, Joe Huang, Jan Kosny, Ron Judkoff, Chip Barnaby, Jim Pegues, Nicholas Long, Erik Kolderup, Dimitri Contoyannis, Katie Ackerly, Sue Reilly, Aleka Pappas, Dave Heinicke, Matt Swenka, Therese Stovall, Mike Kennedy, Jeff Haberl, Phil Haves

Called to order at 6:37 pm

## Introductions

## Program:

- Albuquerque - Had 3 Seminars accepted at this meeting and 1 was rejected on standard on simulating high performance buildings, because it has been rejected previously and won't be resubmitted. 1 Forum.
- Las Vegas – Russ Taylor paper session appear dead without a champion. 2 Seminars to propose – Building Simulation 102 – chaired by Keith Cockerham with speakers and Modeling of High Performance Buildings – chaired by Xia Fang and with speakers. Propose to move these forward to the main committee. Proposed seminar – Modeling of Existing Buildings chaired by Sue Reilly. Possible presenters – Haberl, Judkoff, Reilly Program change will propose a priority level for the seminars for the full TC.
- Montreal – Changes – everything except forums will automatically be submitted to NY PDHs a little more paperwork. Due dates – 9/24/10 for tech papers and abstracts for conference papers (original material papers). Still not completely clear on how the process for entering conference papers are entered and assigned to tracks and programs. Not likely that the session on equation solvers will proceed. Papers on Modeling of Net-zero buildings. Abushakra will have technical paper on research project available in Montreal (on M&V). Solar Decathlon – Haberl reports that ASHRAE is feeling they need to be more supportive of the SD – including RTARs and program ideas. An idea has been floating around concerning modeling support for SD and timing looks promising for this type of session. This would be about what was done by past participants. Recruit participants from 2009 to write papers for Montreal (Haddad will continue to chair). Improve QA procedures for Energy Analysis Results (Balbach offered to chair) Interested speakers should contact Chris

**Proposed Standard TPS** – Building Equipment Performance Data Exchange Protocols for Energy Simulation - Chip Baranaby – a small working group of ASHRAE/manufacturers have developed the TPS and have come to a consensus on the proposal. The Standard will define the data exchange between the manufacturer's data and building energy simulation programs. It has been created with a very broad scope so that it would not have to be changed to include further types of equipment in the future. The plan is to discuss in the subcommittee and bring to the full TC committee meeting for approval vote. The first issue is whether we should proceed with the project and the second is the change of the wording from data exchange format to data exchange protocol. The standard will define the format of the data should be represented for use in building energy software. Dick Lord reported that section 6 unitary equipment ARI has been similarly working on plans for increasing the amount of data and are very supportive of the work. Roger Grant – BuildingSmart – it is a worthy cause and has developed some standard processes in their standards in IFC. Ron Judkoff – well needed, but is the outcome actual data that will allow building simulation. Micheal Wetter – how does this differ from IFCs – this work will represent more fully the performance of the equipment. Teresa Stovall – make sure that the information is useful in BIM. Michael Bobker – is enough know to produce the protocol without limiting the future development of the field or will it stifle future

research – good debate but should be handled by the committee and even standardizing the current published data would be a helpful process. Joe Huang – what is the end product? Is it like Window 4 files for a piece of equipment? – something like XML where the type of equipment is defined and the type of parameters which define the performance. Phil Haves – this could greatly enhance IFCs – the wording eliminates things like windows and wall materials – the idea is to focus this work on the equipment Teresa Stovall – does the word building limit away from refrigeration and central plants.

**Proposal** – change the word building to HVAC&R – but does this exclude things like PV – **Proposal** – add “and related equipment” after HVAC&R in the scope.

Micheal Bobker – how would the data be vetted once submitted – that would be the responsibility of the committee to determine – ARI would want the procedures to ensure the data is correct. Protocol vs Format – protocol would be a process and not the data. Format would be more like the data. We don’t want to just define the data, but also the interaction between the programmers and the manufacturers. Protocol was pushed by ARI because manufacturer’s are already producing these things as full programs.

**Strawman** – majority wants this to go forward

**Topics from Orlando Meeting:**

follow-on to 1456-RP on modeling and simulation of natural and hybrid ventilation (Huang)

- establishment of a Standards Committee on HVAC Equipment Performance Data Formats for Energy Simulation - a related issue is generation of curve fit coefficients for equipment simulation (Barnaby)

- better match of simulation to measured building energy (Koran, Haves)

- possible adoption of Modelica for collaborative development and dissemination of models, including models produced by ASHRAE research - other applications of Modelica, e.g. rapid prototyping by end users could also be considered (Wetter)

- validation research to support Standard 140, e.g. extension of 865-RP (Judkoff, Neymark)

- COMnet - relationship to ASHRAE, e.g. labeling, Standard 140 (Haberl, Neymark)

**Brainstorming Ideas –**

TC5.3 – RTAR – cosponsorship - chilled beams

WS – “Develop comprehensive performance rating procedure for unitary equipment” TC8.11 – the WS has been circulated electronically – any comments should be sent to the Research committee chair.

**Possible Topics:**

Natural Ventilation (follow-on to RP1456) (7)

Reconciling Simulation with Actual Data (10)

Modelica for simulation (7)

Validation Issues (model algorithms) (2) (add to reconciliation)

COMNet (5)

---

ASHRAE TC 4.7 Energy Calculations  
**Subcommittee**  
Tuesday, January 26, 2010, 3:30-5 pm  
Albuquerque, New Mexico

Attendance: Tim McDowell, Jeff Haberl, Michael Wetter, Erik Kolderup, Kwang Ho Lee, Xiufeng Pang, Joseph Firrantello, Dave, Heinicke, Sue Reilly, Bass Abushakra, Kamel Haddad, Ron Judkoff, Joel Neymark, Chip Barnaby, Ron Nelson, Phil Haves

Called to Order: 3:43 pm

#### Introductions

**Handbook** – some minor changes are needed. A review is needed to develop a change list. One review has been received from College of Fellows – comment is that is too technical and not enough practical information. Chair proposes that one comment be reviewed and form a subcommittee to review the chapter in the next few months. Previous revisions missed the last deadline and we need to be sure that the next deadlines are not missed again. (Volunteers to review: Barnaby, Judkoff, Neymark, Haberl, Kolderup)  
Handbook Subcommittee will review the chapter and bring outline of changes to the Las Vegas meeting.  
Handbook should have its own slot in future meetings.

#### Modelica Break-out:

Team up with TC1.4 controls – demonstration project to use Modelica to model controls with HVAC component models and test control sequences. This could include coupling to actual control hardware.

- Started 10 years ago. Meant to be a new language.
- Modelica association started.
- Separates solver from model.
- Each model is encapsulated with solvers.
- Models can be connected graphically
- Two implementations
- What role should TC 4.7 have in furthering the use of Modelica
- HVAC01, HVAC02 and LOADS toolkits might be rewritten in Modelica
- Need open source version of toolkits rewritten in Modelica
- ASHRAE may do a “demonstration toolkit” using Modelica with TC 1.4
- Is there some relationship between the “controls” simulations installed in controls boxes and “controls simulations”. Could ASHRAE develop a collaboration with controls companies.
- Develop component models using Modelica
- Simulink, Matlab already have this in the automotive industry
- RTAR to research what has been done, and develop demonstration toolkit, get solvers ready for prime time.
- Simulation today is based on 30 year old technology.
- Such a toolkit would be dependent on “solvers”.
- Would Modelica be better served in the “controls” simulations arena.
- Proposal would actually require contractor to develop Modelica simulation and include an A/D board that converts simulation into signals that an actuator can use.
- This appears to be part of ASHRAE Research Plan to develop emulator.
- Versions of this are in use by BMW to simulate automobiles.
- Demonstration toolkit: LOADS, HVAC02, HVAC01, emulator
- Controls companies are interested in suite of tools to do testing of controls before going into a building using emulator.

---

Working Group: Wetter, Barnaby, Haberl, McDowell, Zuo

**Natural Ventilation:**

Talking about RP1456 and moving forward. The final report will be recommended for vote for completion. The consensus is to move forward with phase 2. There is concern about whether a new RTAR is needed even though the previous RTAR mentioned a phase 2. Joe H will clarify whether a new RTAR is needed. But since a new WS is needed, the committee can move forward with basic planning even if a RTAR is not needed

Development of data sets for validation of natural ventilation models (this would need to be experimental since the contractor could not find adequate data sets in phase 1). How detailed would we need to get in a workstatement concerning the actual experiments to be performed or leave that up to the contractor? There are recommendations in the final report of RP1456.

Need a working group to take recommendations from the RP final report and start development of RTAR/WS. Concerning the complexity of the work – is ASHRAE the right place for this work or is co-sponsorship enough to help with costs?

Other future work –

More investigation of air flow with surface heat transfer

Design guidance for designers using these coupled airflow/thermal models

Working group for this topic: Kolderup, Huang, Rees(?)

**COMNet**

No RTAR, but the development of a working group/subcommittee to review the technical guideline and report to TC and 90.1. Also propose a forum in Las Vegas on “What is COMNet?”

Will try to contact Ron Jarnigan to determine a timeline for comments to be received on the use of COMNet in ASHRAE bEQ.

**Reconciling Simulation with Measured Data:**

To make better predicts of actual performance of building models – number of different parts and pieces – occupant behavior, controls, sensitivity analysis of inputs, defining protocols for getting proper inputs. As there been previous research on this topic (RP1051) and work should be built upon.

Working Group: Bobker, Stovall, Moura, Abushakra, Hart, Balbach

**Chilled Beams:**

RTAR for co-sponsorship for TC5.3 – The RTAR needs improvement based on the comments from the subcommittee.

## Attachment C

**ASHRAE**  
**Technical Committee 4.7 Energy Calculations**  
**2010 Research Plan (Jan 29, 2010)**

<b>Title</b>	<b>Society status</b>	<b>TC 4.7 Status</b>	<b>Actors or TC 4.7 Prime Contact</b>	<b>Subcommittee*</b>
<b>Active projects</b>				
1197-RP Update energy calculations for Residential HVAC equipment	awaiting final disposition	Project completed, but forms need to be turned in to ASHRAE	Barnaby (chair)	SCM
1416-RP Development of Internal Surface Convection Correlations for Energy and Load Calculations	project underway	Third PMS meeting held Orlando Jan '10	Contractor: UTexas PMS: DFisher (chair), SBruning, JKosny	SCM
1456-RP Assess and implement natural and hybrid ventilation models in whole-building energy simulations	project underway	Contractor delivered final report Oct '09; PMS met in Orlando, but could not vote due to lack of quorum, PMS will review final report and do a letter ballot by Mar '10, 6-mos. NCX to July '10.	Contractor: UColo PMS YJHuang (chair), PHaves, JHensen, RBanks, CScrutton, XDWang, HDavies	SCM
1404-RP Modeling, analysis, and reporting protocols for predicting annual energy performance from short-term building energy monitoring	Project awarded Jul 09, contract signed Sep 09	First PMS held in Orlando Jun10	Contractor: UMilwaukee PMS: RSonderregger (chair), JHaberl, VSmith	DDM
<b>WSs approved by TC</b>				
1588-WS Procedure to create hypothetical layer-by-layer fenestration descriptions when only the bulk properties such as U-factor and SHGC have been defined	RTAR accepted Jan 09	TC 4.5 voted to co-sponsor; WS approved by full committee in Orlando Jan '10 to be forwarded to RAC.	YJHuang (WS author), proposed PES JHaberl (chair), CBarnaby, TMcDowell, + TC4.5 rep to be determined	A
<b>co-sponsored WSs under development</b>				
WS-1413 Developing standard procedures for filing missing weather data (TC 4.2 lead)	WS returned to TC4.2 Jun '09, TC 4.2 letter ballot of revised WS to be held after Orlando	Co-sponsorship approved by full committee in Salt Lake City Jun 08	YJHuang (TC 4.7 contact)	DDM

**Attachment D**

TC 4.7 Program Plan  
ASHRAE Meeting  
6/28/10

**Jun 26-30, 2010 - Albuquerque, NM      Theme: Energy Efficient System Design for High Elevations and Dry Climates**

- Priority #1 Seminar “Building Energy Simulation 101” scheduled  
Track: Energy Facts vs. Simulation  
Organized by: TC 4.7  
Chair: Timothy McDowell  
Status: New
- Priority #2 Forum “Should ASHRAE Develop a Standard for Simulation Aided Design of High Performance Buildings” rejected  
Track: Sustainability/LEED  
Organized by: TC 4.7 (Applications)  
Chair: Jason Glazer  
Status: Since 6/08
- Priority #3 Seminar “Simulation of HVAC/R equipment and systems using the limited data published by manufacturer” scheduled  
Track: Energy Facts vs. Simulation  
Organized by: TC 4.7 (Simulation and Component Models)  
Chair: Michael Wetter  
Status: Since 6/08. Joel Neymark, Vincent Lemort, Craig Wray.
- Seminar “BIM Load Calculations - Pain or Pleasure? A Case Study Involving the ASHRAE Headquarters Building”  
Track: Professional Skills  
Organized by: TC 4.7 (co-sponsored with TC 4.1)  
Chair: Glen Friedman
- Forum “The Human Element: Difficulties in Analyzing and Simulating Occupant Behavior and the Resulting Impacts on Energy Modeling” scheduled  
Track: Energy Facts vs. Simulation  
Organized by: TC 4.4 (co-sponsored by 4.7)  
Chair: Joe Huang

**Jan 29-Feb 2, 2011 - Las Vegas, NV      Theme: Zero Energy Design**

4/9/10 Technical Papers and abstract of Conference Papers due;  
6/4/10 to 8/6/10 Seminars/Forums submission period;  
8/6/10 Draft conference papers due (final versions due 10/8/10)

Tracks: Codes and Standards in the HVAC&R Industry - Integrated Design - Low Energy Design - Refrigeration Update - Industrial HVAC&R - Net Zero Energy - HVAC Systems and Equipment - Professional Skills - HVAC Fundamentals and Applications

Conference Paper “Use of Building Energy Simulation in Energy Code and Policy Analysis”  
Organized by: TC 4.7

---

Chair: Russ Taylor  
Status: Since 1/09. 3 speakers (R. Taylor, R. Brahme, K. Otto)

Seminar "Building Energy Simulation 102"

Track: Professional Skills  
Organized by: TC 4.7  
Chair: Keith Cockerham  
Status: Since 1/10

Seminar "Modeling of High Performance Buildings"

Track: -  
Organized by: TC 4.7 (Simulation and Component Models)  
Chair: Xia Fang  
Status: Since 6/08. (Baumann/Reiser, Bonnema/Pless, Hydeman)

Seminar "Modeling of Existing Buildings"

Chair: Sue Reilley  
Status: new

**Jun 25-29, 2011 - Montreal, Quebec      Theme: Net-Zero Buildings**

Transaction "Use of 'equation solvers' for Simulation"

Organized by: TC 4.7 (Data Driven Models)  
Co-Chair: Jean Lebrun/Michael Wetter  
Status: Have 1 paper (Lebrun), need one more paper.

Seminar "Simulation Support for the Solar Decathlon"

Track: Applications  
Organized by: TC 4.7 (Applications)  
Chair: Kamel Haddad  
Status: Since 6/07. Has speakers.

Seminar "You don't know what you've got 'till it's checked! The importance of QA in benchmarking energy analysis results"

Organized by: TC 4.7 (Simulation and Component Models)  
Chair: Chris Balbach  
Status: New . Speakers (BESTEST EX, ?)

**Dropped:**

Seminar "Shoot-out of Code Compliance Simulation for Residential Buildings"

Organized by TC 4.7 (Applications)  
Chair: Jeff Haberl  
Status: Since 1/07

Seminar "Experience with Simulation of Standard 90.1 Code-compliant Buildings"

Organized by TC 4.7 (Applications)  
Chair: Carol Gardner  
Status: Since 1/07

Seminar "Methods of Carbon Credit Certification from Energy Efficiency and Renewable Energy"

Organized by: TC 4.7 (Data Driven Models)  
Chair: Kris Subbarao  
Status: Since 6/07. Confident to get 3 speakers.

Seminar “Applying Performance Assessment Tools to mitigate Climate Change”

Organized by TC 4.7 (Applications)

Chair: Carol Gardner

Status: Since 1/08. May get 4 speakers, but none confirmed.

Seminar “Advanced Inverse Modeling Techniques using Interval Data”

Organized by: TC 4.7 (Data Driven Models)

Chair: Jeff Haberl

Status: Since 1/08.

## Attachment E

**SSPC 140 ALBUQUERQUE MEETING SUMMARY – 6/28/10 (SUBMITTED 6/28/10)***Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs.*

**ANSI/ASHRAE Standard 140-2007 Addendum B** (HERS BESTEST adaptation by FSEC/JNA) will be published this summer, pending completion of final editorial changes by ASHRAE Staff. The addendum proposes a separate new section in Standard 140 (to facilitate reference by others) for test cases for more simplified building energy analysis tools commonly used for residential modeling. The addendum also includes an *informative* (non-mandatory) annex containing example procedures for developing acceptance range criteria adapted from HERS BESTEST.

**ANSI/ASHRAE Standard 140-2010, Proposed Addendum A** (BESTEST In-Depth Ground-Coupling adaptation by NREL/JNA) was approved by SSPC 140 for publication/public review via letter ballot closed Apr 22, 2010. Public review will occur Fall 2010.

**ANSI/ASHRAE Standard 140-2010, Proposed Addendum B** (BESTEST Multi-Zone Non-Airflow adaptation by NREL/JNA) was submitted to SSPC 140 for initial review Feb 27, 2010. Initial PC review comments were submitted at this meeting. PC letter ballot for publication/public review is planned for this summer.

Content of the test suite is:

- Multi-zone envelope test cases (developed by NREL in collaboration with IEA 34/43) including:
  - Analytical verification conduction test
  - Comparative tests of
    - The effect of shading on a window, where a shading device is affixed to the window of a neighboring zone
    - The effect of shading on a window by a neighboring zone of the building
    - Internal windows.

**Standard 140-2010 Continuous Maintenance (CM) Revision** will be assembled by ASHRAE Staff during Autumn/Winter 2010. This will add the following to the current version of Std 140-2007:

- 140-2007 Addendum A (updated modeler reports to match content and format of those used for posting Standard 140 results on the DOE Tools Directory web site)
- 140-2007 Addendum B (HERS BESTEST adaptation described above)
- Errata related to Section 5.4 (Furnace tests), including update to informative DOE-2 input files, and editorial revisions to relevant normative and informative sections.

The CM revision will also make all informative example results as electronic only.

**Current IRS rules** (IRS notice 2008-40, published Apr 2008) relating to the deduction for energy efficient commercial buildings require software used for assessing tax credits be tested to Standard 140-2007. Currently 9 programs have satisfied the new requirements. **New submittals are to be directed to brent.griffith@nrel.gov.**

NREL is proceeding with **adaptation for Standard 140 of ASHRAE RP 865 (by Yuill and Haberl) – air-side mechanical equipment analytical verification test cases. RP 865 includes 78 test cases over 7 air-distribution systems with similarly varied loads, set points and economizer controls.** The tested systems are: constant volume terminal reheat, VAV, single fan constant volume dual duct, dual fan VAV dual duct, single-zone air conditioner, four pipe fan coil, four pipe induction. **The adaptation will include full NREL/IEA-type simulation trials with SSPC 140 (and others invited to participate).** The spec will be revised as indicated by the simulation trials. **Distribution of an initial Std 140-adapted test specification with a very limited set of test cases to address fundamental modeling issues is planned for Summer 2010.** Several rounds of simulation trials are expected, with

incremental expansion of the test specification. Completion of the work is planned for Summer/Fall of 2011. After that the test suite will be submitted to SSPC 140 for publication/public review recommendation.

**SSPC 140 is developing a new erratum for the Furnace cases developed by NRCAN.** This is to correct a minor discrepancy with developing equivalent base case furnace loads for programs that cannot directly input specified surface coefficients.

## BESTEST-EX UPDATE

This is a **new comparative test suite being developed for testing the ability of software used for modeling residential retrofits to predict energy savings.** Part of the test process also tests the ability to initially calibrate the model of the existing building (pre-retrofit). The soon-to-be-published **Phase-1 Test Procedure** includes a set of **building physics tests with calibrated energy savings test versions of the physics tests.** The test cases are **based on HERS BESTEST, but with improvements** including to equivalent constant surface coefficients (lower values based on recent advancements in the modeling state of the art) and Sherman-Grimsrud infiltration modeling. Test case **parametric variations** include the following retrofits: **air sealing, attic insulation (blown cellulose), wall insulation (blown cellulose), thermostat setback, low-e windows, exterior shading, cool roof, and all retrofits combined.** There are also a number of **targeted calibration scenarios** including targeted high and low space heating energy consumption base case scenarios, and fully random selection base case scenarios. Future test cases would be developed for BESTEST-EX to address furnace and space cooling system retrofits, duct leakage, and domestic hot water modeling. Additionally, other building physics test cases for BESTEST-EX could be cross-referenced from HERS BESTEST. **SSPC 140 is beginning discussions of adapting BESTEST-EX (B-EX) for Std 140, Section 7. Incorporation of the B-EX physics test cases and reference results is ok. SSPC 140 identified discussion issues related to adapting the calibrated energy savings test cases, including:**

- Reference results for the calibrated savings test are blind (3<sup>rd</sup> party review is required)
- If manual calibration is allowed then is the user being tested? And do the calibration test cases then fall outside 140's scope (which is testing programs)?
- Is automated calibration within the scope of Std 140 ("These standard procedures apply to building energy computer programs that calculate the thermal performance of a building and its mechanical systems.")?

**The International Green Construction Code (IgCC) is considering to reference Standard 140** when its code is published in early 2012. However, IgCC's restrictions on the use of non-mandatory language within normative sections are stricter than what ASHRAE's requirements were when Standard 140 was initially developed, such that IgCC requires revisions to the standard before they can reference it. As this issue with non-mandatory language is an ASHRAE-wide issue, ASHRAE Staff will be assisting us with addressing non-mandatory language issues so that IgCC will be able to cite Standard 140.

**References to Standard 140 in Standard 90.1.** Jim Pegues is working with Jason Glazer (90.1 ECB SubC Chair) to indicate that with respect to 140-2010 (forthcoming CM revision), future references by 90.1 must be specific to Section 5 (Class I) test procedures, which are more appropriate for testing detailed models used with 90.1 modeling. The newly added Section 7 (Class II) test procedures are more appropriate for testing simplified models commonly used for low-rise residential modeling. Standard 90.1 will not be able to reference 140-2010 until after 140-2010 is published. After publication of 140-2010, 90.1's referencing of 140-2010 can be via an addendum to 90.1-2010. The next CM revision of 90.1 that can reference 140-2010 is 90.1-2013.

**Other references to Standard 140.** Standard 140 is also referenced by

- Standard 189 (High Performance Green Building Design) Appendix D
- The newly developing COMNet (BPI, Energy Foundation et al) User's Manual.

- Implicitly referenced for ASHRAE Building Energy Quotient IF that is based on the COMNet User's Manual;
- RESNET plans to reference Section 7 tests (140-2007 Addendum B) after they are published.

**In Orlando (Jan 2010) P. Haves (TC 4.7 Chair) requested a listing of validation test suites be presented at the meeting** (for discussion relating to models that address advanced energy design). A comprehensive listing requires a literature survey. A quick listing of test suites either included in Std 140 or listed in Annex B18 (of Std 140) for future reference include:

*Analytical Verification Tests and Comparative Tests already in Standard 140 (or with addenda in progress)*

- NREL/IEA 12/21 "IEA BESTEST" (building thermal envelope fabric load tests)
- NREL/IEA 22 "HVAC BESTEST Volume 1" (analytical verification tests)
- NREL/IEA 22 "HVAC BESTEST Volume 2" (comparative tests)
- NRCan/IEA 22 "Furnace BESTEST" (analytical verification and comparative)
- NREL/HERS Council "HERS BESTEST" (comparative tests, simplified residential)
- NREL/IEA-34/43 "Ground-Coupled Slab-On-Grade In-Depth Tests" (analytical verification)
- NREL/IEA-34/43 "Multi-Zone Non-Airflow" (analytical verification and comparative)
- ASHRAE RP-865 "Air-Side Mechanical Equipment Analytical Verification Tests"

*Other Analytical Verification and Comparative Tests*

- NREL "BESTEST-EX" (comparative physics and calibration tests, existing homes)
- ASHRAE RP-1052 "Development of an Analytical Verification Test Suite for Whole Building Energy Simulation Programs – Building Thermal Fabric"
- "RADTEST Radiant Heating and Cooling Test Cases"
- IEA-34/43 Airflow Tests by Japan (final report still in progress)

*Empirical Validation Tests*

- IEA-34/43: "Empirical Validations of Shading/Daylighting/Load Interactions in Building Energy Simulation Tools (EMPA, Switzerland)
- IEA-34/43 "Chilled Water and Hot Water Mechanical Equipment and Control Comparative and Empirical Validation Tests (empirical and comparative, TUD, Germany)
- IEA-34/43 "Double-Skin Façade Empirical Validation Tests" (Aalborg U., Denmark).
- IEA 22 "Daylighting/HVAC Interaction Tests for the Empirical Validation of Building Energy Analysis Tools (Iowa ERS, US)
- IEA 22 Economizer Control Tests for the Empirical Validation of Building Energy Analysis Tools (Iowa ERS, US and Spain)
- "ETNA BESTEST Empirical Validation Test Specification (NREL and Electricite de France)
- IEA ECBCS Annex 42: Comparative Testing and Empirical Validation of Annex 42 Models for Residential Cogeneration Devices (NRCan)
  - [http://cogen-sim.net/index.php?pg=&download=Annex\\_42\\_ST\\_B\\_Final\\_report\\_on\\_comparative\\_testing\\_and\\_empirical\\_validation.pdf](http://cogen-sim.net/index.php?pg=&download=Annex_42_ST_B_Final_report_on_comparative_testing_and_empirical_validation.pdf)
- New Research: There is a possibility of developing a test facility for empirical validation of software used to model retrofits of existing building (i.e., software that is currently the subject of the BESTEST-EX test suite). Such a test facility would be expensive relative to developing comparative and analytical verification tests, but such expense would be well justified if U.S. energy policy moves towards supporting energy efficiency retrofits of energy-inefficient houses that comprise a large portion of the current U.S. housing stock.

Full SSPC 140 meeting notes are available from the Chair on request.